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NATIONAL BUREAU OF STANDARDS REPORT

4341

REPORT
ON
THE LUMINOUS INTENSITY OF 8 LAMPS
AND
THE LUMINOUS FLUX OF 8 LAMPS
FOR
INTERCOMPARISONS TO BE CARRIED OUT
AT
BUREAU INTERNATIONAL DES POIDS ET MESURES

By

Ray P. Teele
Velma I. Burns



**U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS**

U. S. DEPARTMENT OF COMMERCE

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THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section is engaged in specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant reports and publications, appears on the inside of the back cover of this report.

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Building Technology. Structural Engineering. Fire Protection. Heating and Air Conditioning. Floor, Roof, and Wall Coverings. Codes and Specifications.

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Radio Propagation Physics. Upper Atmosphere Research. Ionospheric Research. Regular Propagation Services.

Radio Propagation Engineering. Frequency Utilization Research. Tropospheric Propagation Research.

Radio Standards. High Frequency Standards. Microwave Standards.

● Office of Basic Instrumentation

● Office of Weights and Measures

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Photometry and Colorimetry Section
Optics and Metrology Division
(File Ref. 1100)

NBS

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This report describes the method of measurement and gives the values of luminous intensity and luminous flux of lamps representing the photometric units as maintained at the National Bureau of Standards. These units are, (1) the candela at 2042°K, (2) the candela at 2353°K, (3) the lumen at 2353°K, and (4) the lumen at 2788°K.

1. PURPOSE

This report gives the values found in 1954 and 1955 to represent the four photometric units maintained at the National Bureau of Standards.

2. MATERIAL

The lamps are all of special construction in accordance with the desires of the Bureau International des Poids et Mesures, which supervised the manufacture of the lamps in France.

3. STANDARDS

The lamps were calibrated in terms of groups of standards representing the four photometric units maintained at the National Bureau of Standards. These groups of standards are as follows:

(a) Candela at 2042°K. Group consisting of lamps BS 2395, BS 2398, BS 2399, BS 2400, BS 2401, BS 2402, BS 2407, and BS 2270. The mean of the eight lamps is 16.817 candelas. This group of lamps was originally calibrated against the primary platinum black body in 1937 and is assumed to have remained constant since that time.

(b) Candela at 2353°K. Group consisting of lamps BS 2987, BS 2990, BS 2991, BS 2992, and BS 2993. The mean of the five lamps is 33.60₈ candelas. This group of standards is the current reference group and is the same group used as a base for the lamps sent to the BIPM previously, NBS Test 1.5/122762-2, November 2, 1949. Lamp BS 2986 has been damaged in the interim and is not part of the reference group at this time.

(c) Flux at 2353°K. Group consisting of lamps BS 5470, BS 5472, BS 5473, BS 5477, BS 5478, BS 5485. The mean of the six lamps is 444.0 lumens. This group of standards is the current reference group and is composed of lamps from a larger group, part of which were used as a base for the lamps sent to the BIPM previously, NBS Test 1.5/122762-3, November 2, 1949.

(d) Flux at 2788°K. Group consisting of lamps BS 5872A, BS 5873, BS 5875, BS 5876, BS 5877, BS 5878. The mean of the six lamps originally (1927) was found to be 1.0550 times the mean of group BS 1724 or 7564 lumens. Group BS 1724 was the base used at the NBS prior to 1955 but there is evidence of a small change (less than 0.2 percent) in group BS 1724. We have made careful intercomparisons of our four groups of reference standards and find that group BS 5872A is consistent with the other groups and is within 0.1 percent of the value used (7564 lumens). Accordingly, this group of standards has been used for this intercomparison.

4. METHOD

(1) Seasoning. The lamps were burned for a period of 17 hours and then measured for current at a specified voltage. They were subjected to an additional hour of burning and the current again measured. This was continued until no change in current occurred with additional burning for 1 hour.

(2) Luminous Intensity. The luminous intensity measurements were made by a substitution method on a horizontal bar photometer with the lamps operating in a base down position. The orientation was such that the plane of the filament was perpendicular to the photometer axis and the glass supporting structure was turned away from the photometer. The perpendicularity of the plane of the filament was determined by sighting across the plane of the filament at its reflection in a vertical cylinder mounted on the lamp carriage, the center of the lamp socket and the center of the cylinder being on a line at right angles to the photometer axis.

The photometric distance (measured to the plane of the filament) for the lamps at 2042°K was 1.56 meters. The photometric distance for the lamps at 2353°K was 1.25 meters.

(3) Luminous Flux. The luminous flux measurements were made by a substitution method in an 88-inch integrating sphere with the lamps operating in a base-up position.

(4) Photometric Measurements. All measurements were made photoelectrically by using a modified form of the photometer described in NBS J. Research 25, 703 (December 1940), RP 1348. With the voltage held constant at the designated value, readings were taken of the current and luminous intensity or luminous flux. Measurements were made in the following order: three standards, the test lamps, and the remaining standards. Three or more sets of measurements were made, the order of taking the readings being reversed in alternate sets. The results given in 5. Results are the averages of all readings taken.

5. RESULTS

The results are given in Tables A, B, C, and D. The uncertainty of the luminous value (intensity or flux) for each individual lamp was calculated at the 0.1 percent confidence level from the variations in the results in the several sets of measurements. The uncertainty of the average was also computed in this way, and, in addition, was estimated as one-fourth the square-root of the sum of the squares of the uncertainties of the individual lamps. The latter uncertainty estimates are shown in parentheses.

Table A. Luminous Intensity at 2042°K (BIPM 1951 scale)
(2039°K NBS Scale) Measured at 1.56 Meters

Lamp No.	Volts	Amperes	Candela	Uncertainty
NBS 3757	97.200	0.5541 ₉	11.85	±0.10
NBS 3759	97.900	.5593 ₉	11.84	±0.10
NBS 3760	98.600	.5577 ₀	11.88	±0.17
NBS 3762	98.200	.5590 ₃	12.14	±0.13
Average			11.92 ₈	±0.02 ₁ (±0.06 ₄)

Table B. Luminous Intensity at 2353°K (BIPM 1951 Scale)
(2352°K NBS Scale). Measured at 1.25 meters.

Lamp No.	Volts	Amperes	Candela	Uncertainty
NBS 3764	92.300	0.3402 ₀	22.38	±0.12
NBS 3765	91.700	.3425 ₆	21.90	±0.19
NBS 3769	91.800	.3402 ₃	22.03	±0.15
NBS 3770	97.800	.3543 ₁	26.93	±0.11
Average			23.30 ₈	±0.11 (±0.07)

Table C. Luminous Flux at 2353°K (BIPM 1951 Scale)
(2356°K NBS Scale)

Lamp No.	Volts	Amperes	Lumens	Uncertainty
NBS 3780	99.000	0.3205 ₃	232.7	±0.2
NBS 3782	98.500	.3205 ₆	231.6	±0.6
NBS 3783	98.200	.3196 ₃	226.3	±0.7
NBS 3784	99.100	.3215 ₁	233.7	±0.2
Average			231.1	±0.3 (±0.2)

Table D. Luminous Flux at 2788°K (BIPM 1951 Scale)
(2811°K NBS Scale)

Lamp No.	Volts	Amperes	Lumens	Uncertainty
NBS 3772	108.900	1.7369	2719	±12
NBS 3773	110.000	1.7580	2778	±15
NBS 3775	109.000	1.7336	2730	±27
NBS 3776	108.900	1.7437	2733	±11
Average			2740	±16 (± 9)

THE NATIONAL BUREAU OF STANDARDS

Functions and Activities

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to Government Agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. A major portion of the Bureau's work is performed for other Government Agencies, particularly the Department of Defense and the Atomic Energy Commission. The scope of activities is suggested by the listing of divisions and sections on the inside of the front cover.

Reports and Publications

The results of the Bureau's work take the form of either actual equipment and devices or published papers and reports. Reports are issued to the sponsoring agency of a particular project or program. Published papers appear either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three monthly periodicals, available from the Government Printing Office: The Journal of Research, which presents complete papers reporting technical investigations; the Technical News Bulletin, which presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions, which provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: The Applied Mathematics Series, Circulars, Handbooks, Building Materials and Structures Reports, and Miscellaneous Publications.

Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards (\$1.25) and its Supplement (\$0.75), available from the Superintendent of Documents, Government Printing Office. Inquiries regarding the Bureau's reports and publications should be addressed to the Office of Scientific Publications, National Bureau of Standards, Washington 25, D. C.



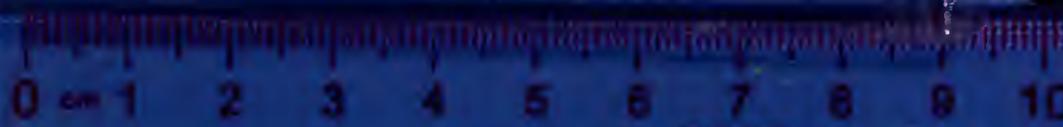
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